HIGH RESOLUTION GEOPHYSICAL SURVEY OFFSHORE OF OCEANSIDE, CALIFORNIA

Field Operation Report

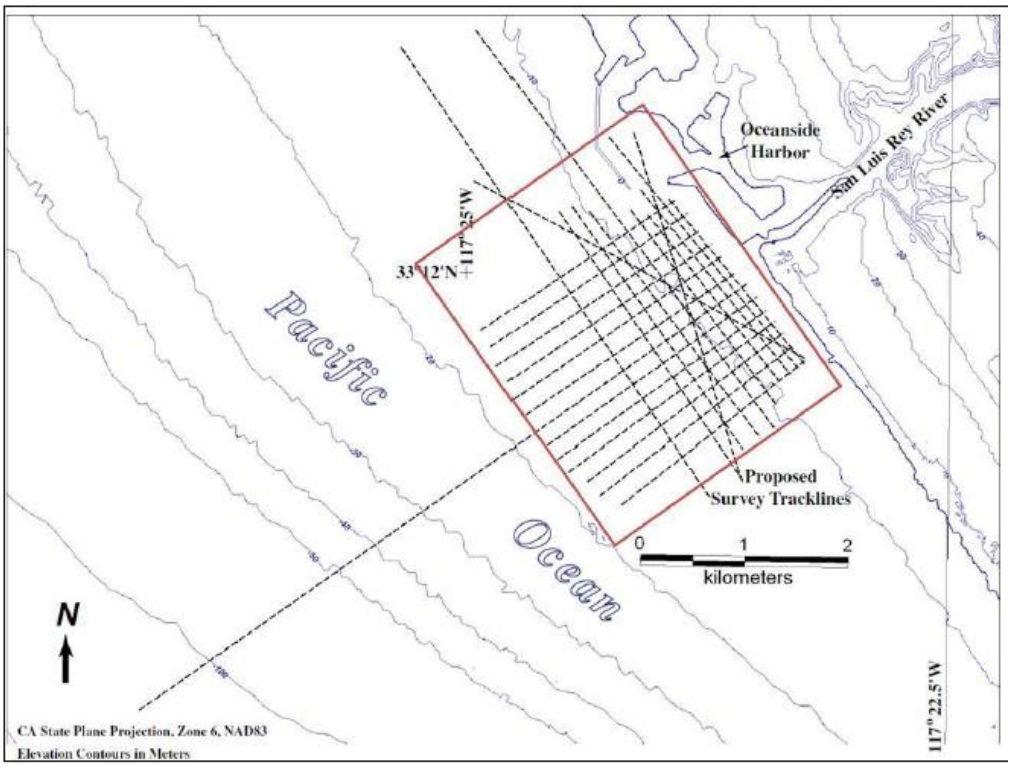

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TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF FIGURES

LIST OF TABLES

HIGH RESOLUTION GEOPHYSICAL SURVEY OFFSHORE OF OCEANSIDE, CALIFORNIA

Field Operation Report

1.0 INTRODUCTION

EcoSystems Management Associates, Inc. (ECO-M), a subsidiary of Coastal Environments (CE) conducted an offshore geophysical survey offshore of the San Luis Rey River in Oceanside, California on 28 April to 1 May 2015, to find a suitable area of the placement of a subsurface intake system for a desalination program.

The project objectives are to carry out the following surveys:

- Shallow seismic survey from just beyond the surf zone to about one mile offshore of the mouth of the San Luis Rey River in Oceanside, California (depth of interest is 100-200 feet).
- Geophysical survey of the offshore alluvial basin for possible subsurface intake system.

These surveys are necessary to determine geological hazards, faults, shallow gas, and soft sediments at the project area.

A shallow seismic survey offshore of Oceanside was needed to characterize the nearshore sub-bottom geology in order to characterize the offshore alluvial basin and its suitability for installation of a subsurface intake system (e.g., infiltration gallery or slant wells) for the proposed desalination program. This intake system would draw saline water from the shallow sediments along the offshore area of the coastline. This approach would ameliorate the problem of saltwater wedge migration into local fresh water wells and eliminate future problems with marine life entrainment during saline water pumping to supply the desalination plant. There is a question regarding the type of alluvial deposits that exist in the offshore basin, their configuration and associated geological structure, and whether they would permit sufficient migration of water to the well head so that it could properly supply water to the proposed desalination facility.

Geological structures related to deformation along the Newport-Inglewood-Rose Canyon (NIRC) fault zone, named the South Coast Offshore Zone of Deformation may exist in the survey area and create potential obstacles to horizontal fluid transport within the alluvial basin. Identification and mapping of these structures is necessary for input to ground water flow models used to evaluate subsurface intake designs. The Newport-Inglewood fault zone is located mostly to the northeast of the project site (Figure 1-1). The principal displacement zone (PDZ) of the NIRC trends N42^{o}W at its location about 5 km (3 miles) west of the coast in the project area. Several branch and secondary faults have been mapped including one trace that crosses the coast in the vicinity of Oceanside (Euge et al. 1972). Deeper structure includes the Oceanside Blind Thrust, a reactivated Neogene (Miocene-Pliocene) detachment fault associated with oblique

rifting and subsequent transpression (dextral oblique-reverse slip). The detailed structure of the buried faults in the Oceanside to Camp Pendleton offshore area are poorly known and the subject of continued research, especially in regard to seismic hazards at the San Onofre Nuclear Generating Station (SONGS). Complex deformation in the hanging wall of the Oceanside Blind Thrust, including the NIRC, may provide some structural control on the coastal and offshore river channel configurations. Tectonic uplift (i.e., tectonic dam) along the NIRC defines the break between the continental shelf and slope in this area.

1.1 PERMITTING: CA STATE LANDS COMMISSION

Prior to the geophysical survey work, ECO-M acquired the necessary permit from the California State Lands Commission (Permit # PRC 8536.9). As per permit requirements, a Marine Wildlife Contingency Plan was prepared and a marine mammal observer was present during the surveys to assure that marine mammals were not harmed by the low energy sonic pulses generated by the geophysical survey equipment. Mammal observations that were carried out during the surveys determined when survey activities should be altered or stopped to avoid interaction with marine mammals. A copy of the Marine Mammal Observer Report during the surveys (28 April to 1 May 2015) is in Appendix A. Additionally, all parties identified in Exhibit C of the permit were sent notification of the geophysical survey activity.

1.2 BACKGROUND GEOPHYSICAL AND GEOLOGICAL INVESTIGATION

Published and other available data regarding the geology of the coastal and offshore region near the site was compiled and reviewed to anticipate what subsurface structure and stratigraphy may be imaged by the seismic reflection profiles. The continental shelf at Oceanside is relatively wider (about 4 km) than most of the shelf between Newport Beach and San Diego. Major river valleys descending west from the Peninsular Ranges cut across this shelf during Pleistocene sea level lowstands (glacial epochs). The river valleys were subsequently filled with sedimentary materials during interstadial transgressions. The resultant offshore alluvial basins are the primary interest for the project as they may represent potential aquifers from which to extract seawater into desalination plant intake systems.

Coastal uplift of previous wave-cut surfaces (i.e., marine terraces), has left several late Pleistocene surfaces stranded above sea level at various elevations in the Oceanside and Camp Pendleton areas (Lajoie et al. 1989; Kern and Rockwell, 1992). Alluvial and colluvial deposits cover the wave-cut surfaces, and multiple surfaces can be identified and associated with different sea level transgressions over the past 1.5 million years. Some of these buried surfaces, particularly for the most recent sea level lowstands and transgressions (OIS-5e; <125,000 years BP), likely exist beneath the seafloor offshore in the project area. Identification of gently west-dipping surfaces in the seismic profiles may provide important stratigraphic control on sub-bottom sediments, but ground truth with boreholes will be required to confirm the age and character of these offshore deposits.

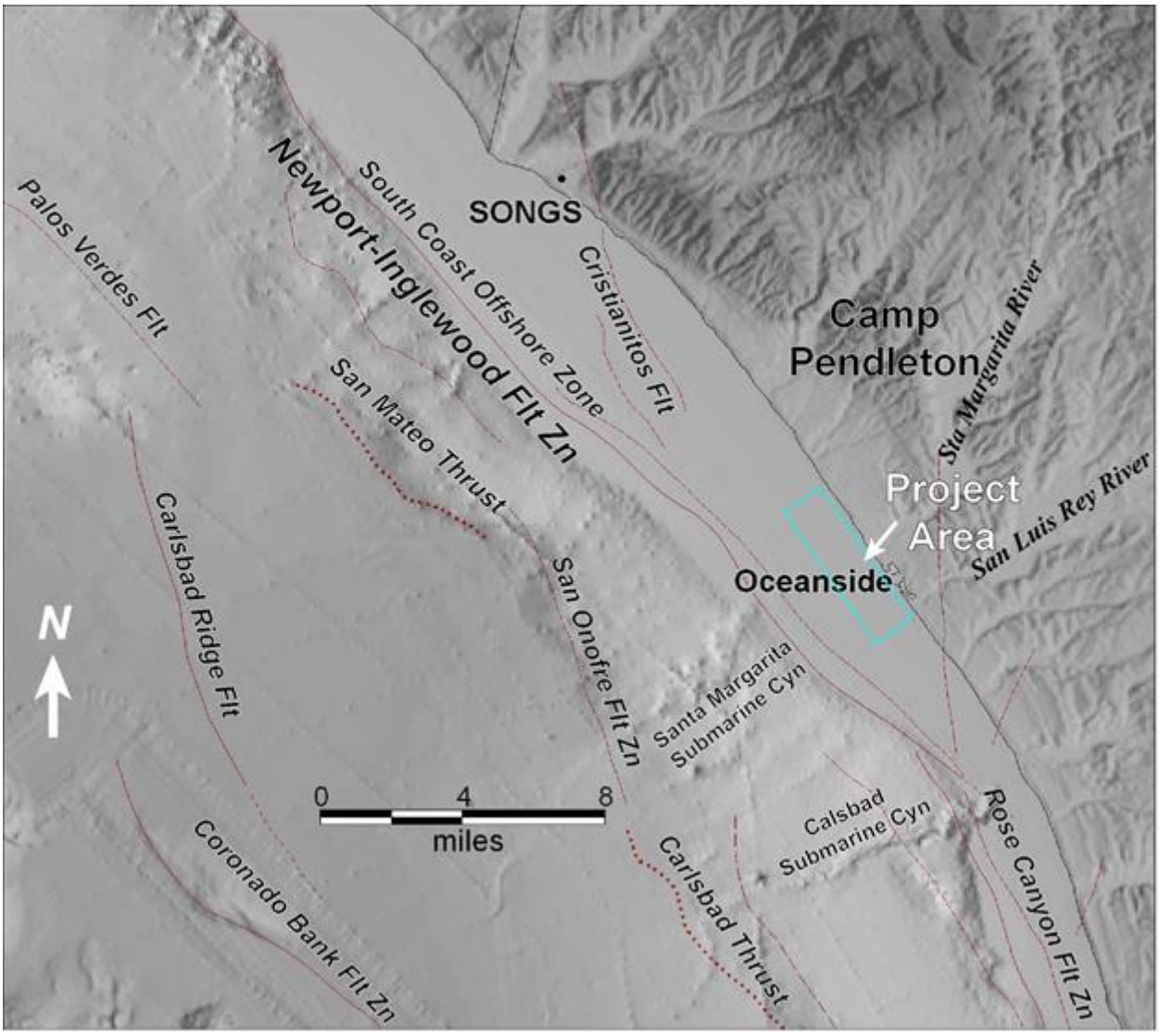


Figure 1-1. Map showing Quaternary Faults identified offshore Camp Pendleton and vicinity (modified from Ryan et al., 2008). Uplift along the Newport-Inglewood-Rose Canyon fault zone offshore near the shelf break produced a tectonic dam that diverts the nearshore paleochannels.

Abundant geophysical reflection data exist in the area due to decades of resource exploration and offshore geophysical surveys by industry, government, and academia to investigate active faulting and geological hazards. Most of these data are farther offshore, beyond the 3-mile limit of state lands due to regulations on seismic source levels in the nearshore zone. A few high-resolution single-channel seismic profiles are available in the area from U.S. Geological Survey (USGS) projects. High-resolution multichannel seismic profiles from many areas in the San Pedro Bay area, including recent lines offshore of Huntington Beach were acquired and processed for this project. Most of these data are located farther offshore than the 1,500-2,000 feet nearshore zone of interest, but provide relevant information regarding the character of shallow sediments and quality of subsurface imaging that may be obtained. The more coarse-grained sediments (sands) in the nearshore region adjacent to the Santa Ana River attenuates the seismic energy somewhat more than the finer grained sediments farther offshore. A high-resolution multichannel seismic reflection survey will provide the best subsurface imaging to enable confident interpretation of geology and potential hazards.

2.0 OFFSHORE GEOPHYSICAL SURVEY

2.1 GEOPHYSICAL SURVEY DESIGN

Based on previous coastal surveys for desalination plants, coastal alluvial basins often exist within prehistoric river channels (paleochannels) associated with Pleistocene sea level lowstands. The Last Glacial Maximum (LGM) sea level lowstand was about 120 meters (400 feet) below modern sea level. The geotechnical report in the EIR notes that the base of Holocene sediments is about 90 feet deep onshore. However, seismic surveys offshore Santa Cruz and Oceanside where significant rivers enter the sea, found major LGM paleochannels filled with Holocene deposits that reached depths of about 200 feet in the nearshore zone. Some of these channels may be fault-controlled with offset layers in Pleistocene or older material beneath the channel base. Consequently, we recorded the seismic reflection data to at least 200 milliseconds two-way travel time which corresponds to a subsea depth of about 500 feet. Because seismic reflection profiling measures the subsurface geological reflections in time (two-way travel time – down and back), it is necessary to have information on the sub-bottom seismic velocity. Multichannel seismic profiling obtains that information from the differential travel times to the offset hydrophone groups in the streamer. The seismic velocity structure is also useful for interpreting lithology. Geological ground truth is still required, however, to confirm interpretations of subsurface geology from seismic images.

Geophysical reflection surveys were used to provide high-resolution images of sub-bottom geological structure and stratigraphy. Typical high-resolution seismic reflection surveys provide vertical resolution from less than 1 foot to about 10 feet for these shallow depths, whereas horizontal resolution can be about 3 feet or less with differential GPS navigation. Although seismic reflection methods appear expensive, marine surveys are very cost-effective as many miles of data may be acquired in a short time once the equipment is deployed and operating. This allows dense coverage of the subsurface and allows more accurate interpretation and mapping of potential hazards.

The depth of seismic imaging is controlled by attenuation of the seismic waves and acoustic noise. The most severe form of noise in marine seismic reflection profiling is created by the echo of the seismic source between the water bottom and the sea surface. This echo is called the water bottom multiple and appears as a duplication of the water bottom at twice the two-way travel time in the seismic profile. The near perfect reflection from the water surface and strong reflection from the water bottom, especially in areas of coarse sediments or bedrock outcrop, results in a strong multiple reflection event that obscures the “primary” sub-bottom reflections from real geology. Single channel seismic reflection profiling systems are unable to attenuate the water bottom multiple and can rarely image any geology below this coherent noise event. Thus, in water depth of 50 feet, the water bottom multiple will appear at 100 feet subsea depth and obscure the geological image at greater depths. Multichannel seismic profiling, where the streamer uses several groups of hydrophones to record the seismic wave energy, enables attenuation of the water bottom (and other) multiple wave energy based on the differential arrival times of the reflected waves at each geophone group.

Why is Multichannel Seismic Profiling Necessary?

- Multichannel profiling attenuates water bottom multiple (critical need in coarse-grained shallow water sediments).
- Multichannel profiling provides better signal-to-noise ratio (SNR) than single-channel profiling enabling more confident interpretation of subsurface geology.
- Multichannel profiling provides velocity information on subsurface sediments necessary to convert time-domain seismic profile to depth.

2.2 GEOPHYSICAL SURVEY EQUIPMENT

The profiling system consisted of a 300-joule boomer acoustic source and a 24-channel GeoEel hydrophone streamer with group interval of 1.56-m (5-ft). The multichannel system is shown in Figure 2-1. The boomer source is capable of producing acoustic energy pulses with frequency bandwidth up to about 1,000-Hz, but considering spatial aliasing due to back-scattered acoustic energy in the water column, it normally provides useful bandwidth to about 500-Hz with a short streamer group interval. The final processed seismic profiles were filtered to a bandwidth of 72-640 Hz. At a typical compressional wave velocity in water-saturated sediments of about 1,520 m/s (5,000 ft/s), the sub-bottom resolution achieved is about 1.5-m (5-ft) for half wavelength events or about 0.6-m (2-ft) considering "tuning" effects.

A differential Global Positioning Satellite (GPS) navigation system was used to record the shot points at precisely one-second intervals during acquisition. The differential system used ties to the Coast Guard maintained permanent GPS base station in the area. Nominal GPS position accuracy is about 10 meters, and with differential technique, we achieved sub-meter position accuracy (< 3-ft). The shot point navigation (geographic coordinates) during acquisition was based upon the World Geodetic System of 1984 (WGS84) and were converted to the California State Plane Coordinate System, zone 6, North American Datum of 1983 (NAD83), in feet. Shot point positions were determined by adding corrections for the layback or acoustic source distance behind the GPS antenna on the boat. Digitally-recorded logs of shot points, navigation fixes, and adjacent landmarks were prepared and provide quality control to maintain the highest possible navigational accuracy.

Data were tied to the local datum of Mean Lower Low Water (MLLW) by applying appropriate corrections to the two-way travel time to account for the local tidal variations, depth of source and hydrophone streamer arrays. Conversion of MLLW to Mean Sea Level (MSL) requires addition of 2.82-ft in elevation for the Los Angeles tide gauge in LA Harbor. The multichannel streamer acquisition provides some removal of swell by averaging over several shot points and hydrophone locations, although data become seriously degraded by reflection point smear if heavy swell or bad weather develops.

Figure 2-1. High-resolution multichannel seismic equipment: Above left is the 300-Joule Boomer in Tow; Above Right is the 16-channel GeoEel digital mini-streamer (24-channel version proposed effort). Below is a view of the equipment deployed for a survey offshore Santa Cruz, California. The boomer sled is in the mid-foreground and the streamer tail buoy is the white object in the right center.

2.3 GEOPHYSICAL SURVEY

The survey occurred offshore of the mouth of the San Luis Rey River from just beyond the surf zone to about 1 mile offshore and approximately 1 mile along shore. We recorded the seismic reflection data to at least 200 milliseconds two-way travel time. Because seismic reflection profiling measures the subsurface geological reflections in time (two-way travel time – down and back), it is necessary to have information on the sub-bottom seismic velocity. Multichannel seismic profiling obtains that information from the differential travel times to the offset hydrophone groups in the streamer. The seismic velocity structure is also useful for interpreting lithology. Geological ground truth is still required, however, to confirm interpretations of subsurface geology from seismic images.

A total of 25 profiles were acquired in a rectilinear grid for a total of about 85.4 km (220,300 ft) of trackline length (Figure 2-2). Three (3) long transect lines (one perpendicular to shore and two parallel to shore) were followed in order to correlate to other collected data; two lines (shore-parallel) tie to SANDAG boomer profiles for correlation with stratigraphy from prior investigations and one line (shore perpendicular) follows an older (1979) USGS deep penetration profile, which aided in tying stratigraphy and structure from other published research.

Some profiles consist of multiple pieces (2-3) because of interruptions from equipment problems or marine mammal sightings. The data were acquired with a 300-joule "boomer" acoustic source towed at a depth of 0.3-m (1-ft) below the sea surface. A 24-channel GeoEel™ high-resolution digital streamer with a group interval of 1.56-m (5.12-ft) recorded the reflected acoustic wave energy at a sampling interval of 0.25-ms for a record length 1,200 samples equal to 0.3 sec (300 ms). Common Depth Point (CDP) processing was applied to the data to provide digital seismic images for interpretation on a workstation using the Geographix™ software. Both stacked and migrated seismic profiles were produced for interpretation.

Data quality was established in the field during acquisition by monitoring data being recorded by the digital data acquisition system and by preliminary seismic data processing aboard the boat. The software used for digital recording of the seismic reflection trace data allow display of shot records and some quantitative measures of signal and noise levels. The Vista seismic data processing software was also used on a laptop computer in the field to examine shot records and perform preliminary data processing including brute stacking to insure that data are suitable for interpretation to the target depths and cover the area of interest. Single-channel monitor records from the data acquisition system were also prepared to show data quality and allow preliminary geological interpretation so that any prominent subsurface features identified may be specifically targeted in subsequent tracklines, including extension of the line if necessary. Once underway, it is easy to extend a line for a few hundred feet at minimal cost in time or effort.

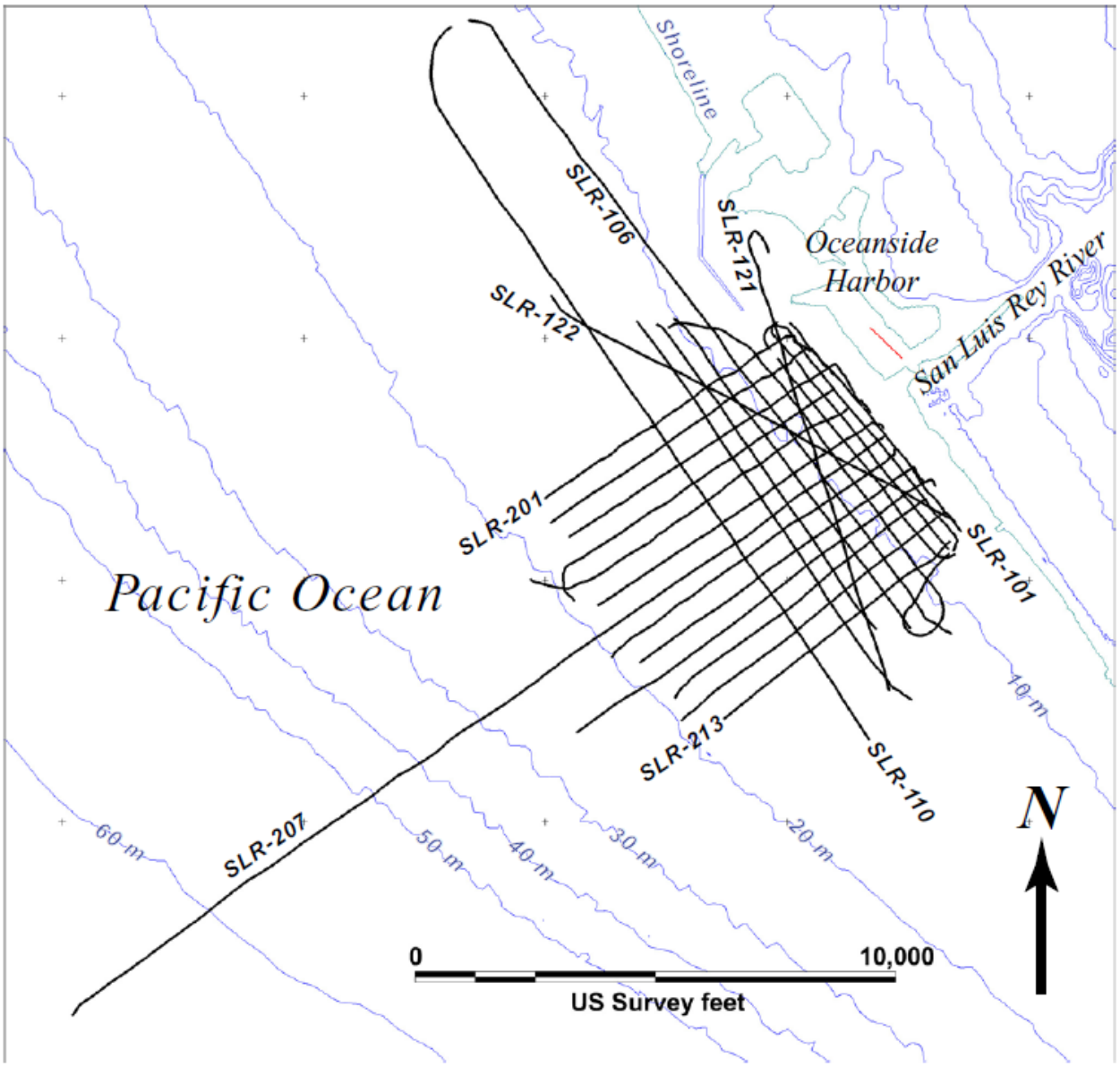


Figure 2-2. Tracklines for the offshore San Luis Rey geophysical survey on 28 April to 1 May 2015.

Table 2-1. Offshore San Luis Rey geophysical survey GPS coordinates (NAD83) for the start and end points of each survey line.

Line	Long Start	Lat Start	Long End	Lat End
SLR-001	-117.4032	33.18339	-117.387	33.193939
SLR-002	-117.405	33.18401	-117.388	33.194978
SLR-003	-117.4061	33.18505	-117.389	33.1959
SLR-004	-117.4077	33.18571	-117.39	33.196697
SLR-005	-117.4087	33.18657	-117.391	33.197493
SLR-006	-117.4096	33.18761	-117.392	33.198463
SLR-007	-117.4445	33.16812	-117.393	33.199363
SLR-008	-117.4115	33.18976	-117.394	33.200125
SLR-009	-117.4126	33.19086	-117.395	33.201441
SLR-010	-117.4131	33.19215	-117.396	33.202272
SLR-011	-117.414	33.19329	-117.397	33.203238
SLR-012	-117.4145	33.19468	-117.398	33.204454
SLR-013	-117.4154	33.19586	-117.399	33.205365
SLR-014	-117.3928	33.18516	-117.402	33.210237
SLR-015	-117.4161	33.20659	-117.387	33.194065
SLR-020	-117.3993	33.20546	-117.387	33.193642
SLR-021	-117.4046	33.20989	-117.388	33.193372
SLR-022	-117.4018	33.20608	-117.389	33.192921
SLR-023	-117.4012	33.20433	-117.39	33.192404
SLR-024	-117.4027	33.20466	-117.39	33.190808
SLR-025	-117.4161	33.21754	-117.39	33.189041
SLR-026	-117.4062	33.20452	-117.391	33.188278
SLR-027	-117.4077	33.20482	-117.393	33.187446
SLR-028	-117.4089	33.20447	-117.393	33.185278
SLR-029	-117.4226	33.21624	-117.396	33.183946
Datum in NAD83				

2.4 SEISMIC DATA PROCESSING AND INTERPRETATION

2.4.1 Data Processing

Data processing was based on the Common-Depth-Point (CDP) wavelet processing method using the commercial seismic data processing program Vista™ (vers. 10) for 2-D seismic reflection data. Processing steps included: trace editing to remove spikes, band-pass filtering to avoid aliasing, spiking deconvolution to shape the zero-phase wavelet, spherical divergence correction to account for wavefront spreading, trace scaling to account for source variability, normal-moveout (NMO) correction using a stacking velocity of 5,000 ft/s, stacking sorted CDP records, and FK migration at 4,800 ft/s to sharpen the image. Static corrections were applied to account for depth of acoustic source and streamer, and remove the tidal elevation. For shallow subsurface marine seismic data, brute stacks at a constant velocity of 5,000 ft/sec provided good seismic images. Velocity analysis at several locations along key profiles (lines 104 and 203) were performed to provide more seismic velocity structure needed for time-to-depth conversion. The results of the velocity analysis showed that a constant velocity of 5,000 ft/sec (1,520 m/s) was valid for stacking the data at the shallow depths of interest. Post-stack migration of the seismic data using the frequency-wave number method with a constant velocity of 4,800 ft/sec (1,463 m/s) provided a sharper image of subsurface structure by collapsing diffractions and moving dipping reflectors to more accurate positions. The processed seismic data products include both stacked and migrated SEG-Y format data files that were loaded into the workstation for interpretation. Printed copies of seismic profiles saved as pdf files were used for quality control during processing and for plots in the survey report.

2.4.2 Data Interpretation

Initial work included review of available data and reports to assist in the final design of the offshore seismic reflection survey and to aid in interpretation of the seismic profiles. Interpretation of the processed seismic profiles was performed on our Interpretation Workstation which uses the Geographix™ subsurface geological interpretation software. Geographix™ includes SeisVision™ software for interpretation of seismic profiles and other modules for interpreting well logs and correlation to seismic data. The embedded GIS (GeoAtlas™) provides mapping capability with output formats that may be used by CAD software systems. Legg Geophysical also uses the MapInfo™ GIS for quality control and preparation of additional maps. The mapping projection used for the project is the California State Plane zone 6 with the 1983 North American Datum (NAD83).

3.0 RESULTS

The results of the seismic profiles for selected transects are shown in Figures 3-1 through 3-3. Daily field logs are found in Tables 3-1 and 3-2.

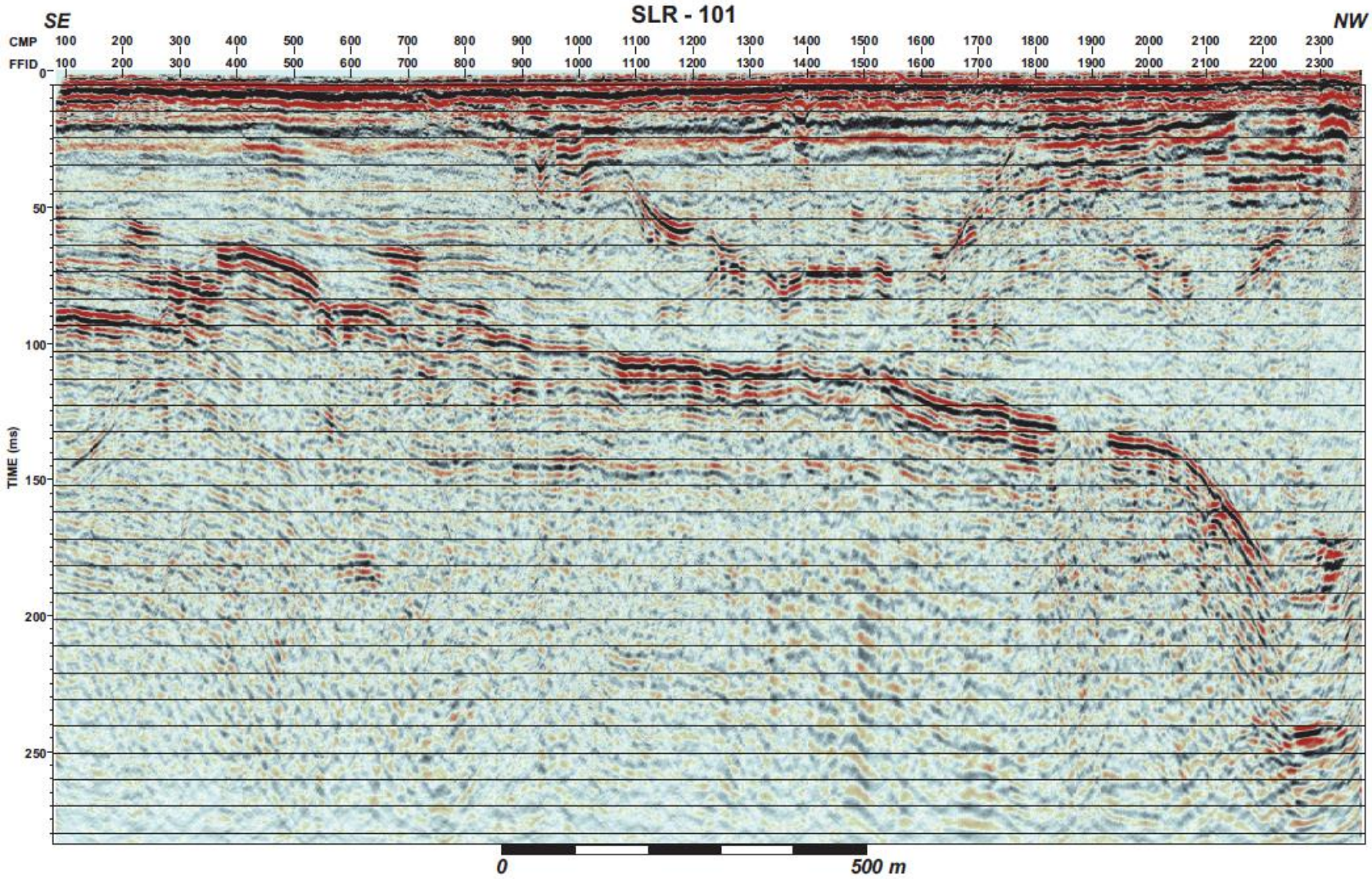


Figure 3-1. Seismic profile for transect 101 from SE(left) to NW (right).

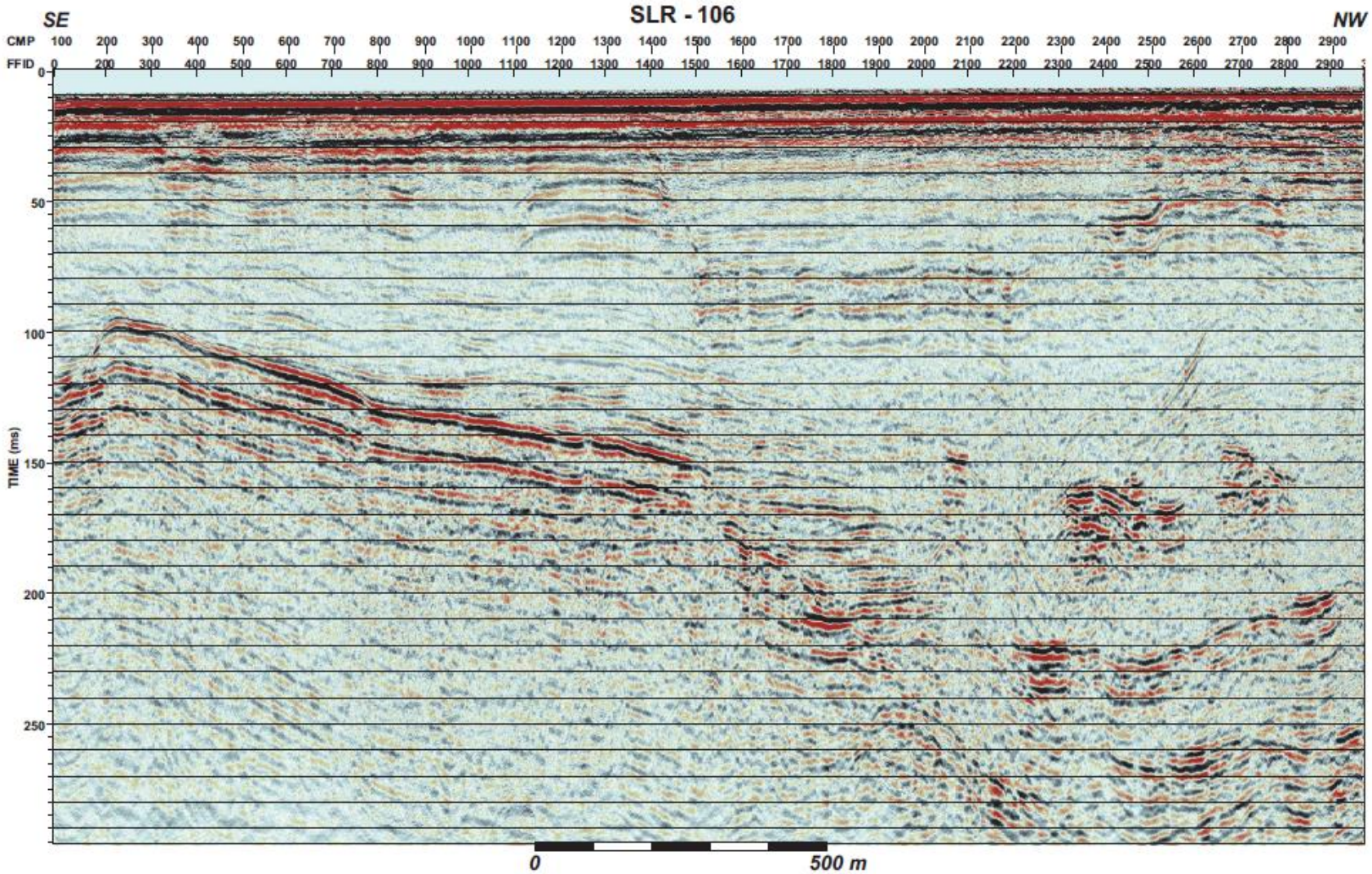


Figure 3-2. Seismic profile for transect 106 from SE(left) to NW (right).

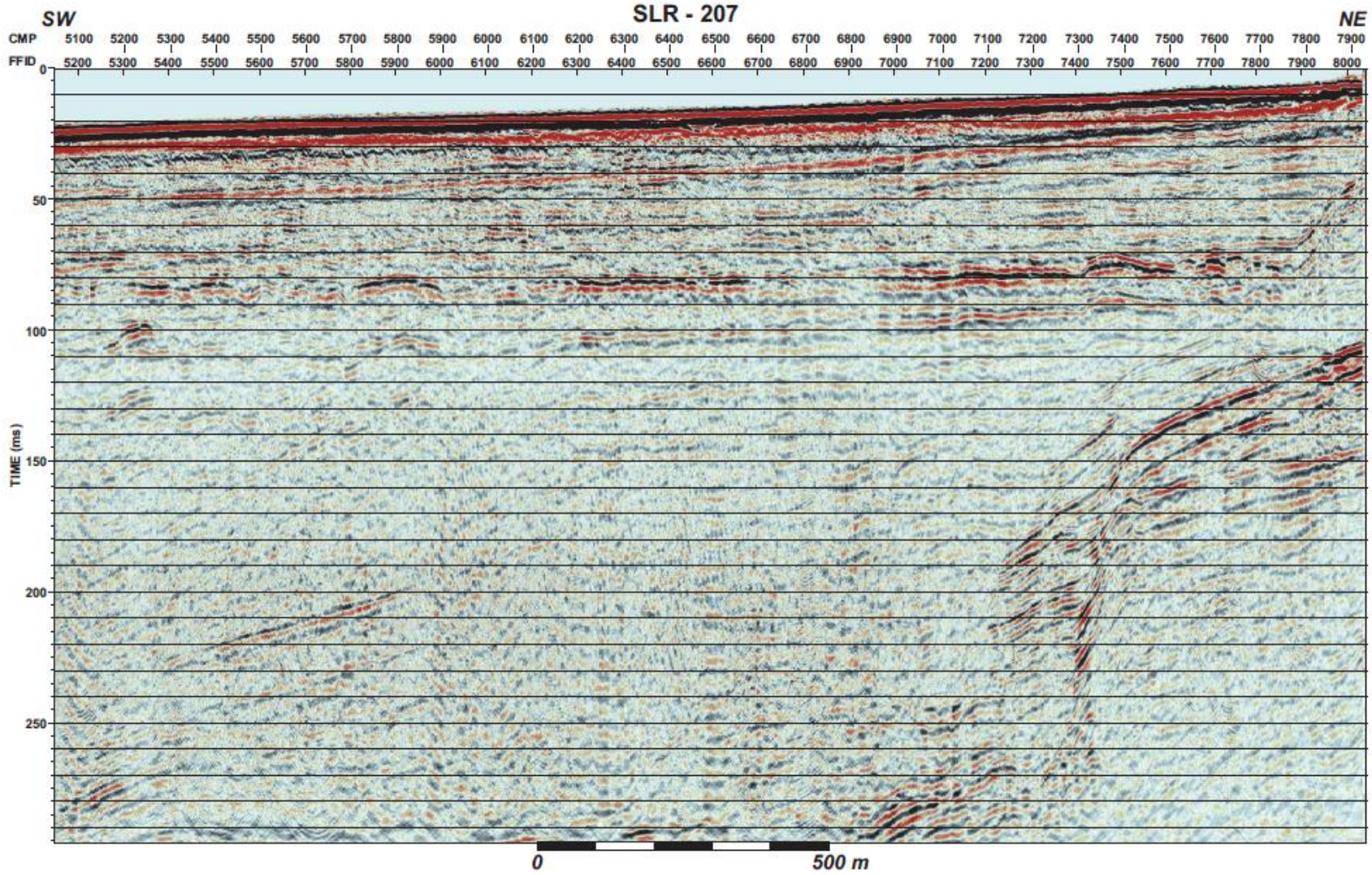
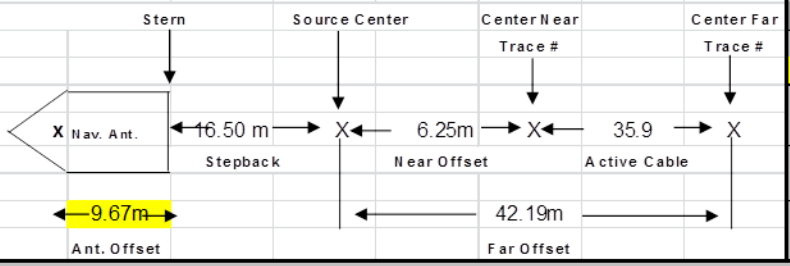


Figure 3-3. Seismic profile for transect 207 from SW (left) to NE (right).

Table 3-1. Field log/observers report for 29 April 2015.

FIELD LOG / OBSERVERS REPORT — Page 1

Vessel: M/V Theory



Client	Date
Geoscience	Apr 29 2015

Area and / or Block: Oceanside

Line number: see below

Operator / Observer: Barth \ Legg

Line Direction: see below

Instrumentation

Source type	Source power	Pre amp gain	Number of Guns	Plates	Sleeves	Source depth	Other
AP1000	300 joules	18 db		1		0.3 m	

	Sample Int.	Record Length	No. of channels
Primary	0.250 ms.	300 msec.	24
Secondary	ms.	Sec.	

Cable depth: 0.3 m.

Signature Hydrophone depth

Filter		Filter		60 HZ Notch	Other
Low	Slope	High	Slope		
Out		Out		Out	

Note: no aux channels recorded

Cable layout

Recording Instruments	Type	Format	Tape Drives	Far TR No.	Far offset
	Geo-Eel	SEG Y (IBM)	Hard Disk/ USB Disk	24	42.19 m.

Navigation System	Primary	Secondary	Near TR No.	Near offset
	Differential GPS - Eco-M		1	6.25 m.

Boat speed	Navigation fix interval	Group Interval	Shooting Interval
4 Knots		1.56 m	0.75 m

File Name	Time UTC	File Number	Speed Rep Rate	Cable depth Meters	Remarks (Changes in weather, sea state, operator, record delays, problems, etc.)	
	1634				Underway	
	1653				Deploy gear	3 ft swell, wind NE @ 5 kt
	1658				Gear deployed	
					Note: Incorrect Date in Geometrics Log/Nav Files	
105.sgy	1704	105	0.4 sec	0.3 m	SOL 105	HDG: 140°
105.sgy	1706	494			Lost TTM	
105.sgy	1707	580			Reacquire TTM	
105.sgy	1717	2046			Lost TTM	
105.sgy	1718	2283			Reacquire TTM	
105.sgy	1728	3750			Lost TTM	
105.sgy	1729	3875			Reacquire TTM	
105.sgy	1733	4450			EOL 105	
102.sgy	1733	102	0.4 sec	0.3 m	SOL 102	HDG: 315°
102.sgy	1739	943			Lost TTM	
102.sgy	1740	1198			Reacquire TTM	
102.sgy	1750	2664			Lost TTM	
102.sgy	1750	2729			Reacquire TTM	
102.sgy	1751	2837			EOL 102	
104.sgy	1752	104	0.4 sec	0.3 m	SOL 104	HDG: 140°
104.sgy	1800	1352			Lost TTM	
104.sgy	1801	1418			Reacquire TTM	
104.sgy	1806	2194			EOL 104	
101.sgy	1808	101	0.4 sec	0.3 m	SOL 101	HDG: 320°
	1810	557			Lost TTM	
	1811	624			Reacquire TTM	
	1821	2089			Lost TTM	
					Continued on Page 2	

FIELD LOG / OBSERVERS REPORT

Page 2

Client	Date	Area and / or Block	Operator / Observer	Line number	Line Direction
Geoscience	Apr 29 2015	Oceanside	Barth/Legg	see below	see below

File Name	Time UTC	File Number	Speed Rep Rate	Cable depth Meters	Remarks (Changes in weather, sea state, operator, record delays, problems, etc.)
101.sgy	1821	2159	0.4 sec	0.3 m	Reacquire TTM
101.sgy	1823	2337			EOL 101
103.sgy	1823	103	0.4 sec	0.3 m	SOL 103 HDG: 140°
103.sgy	1831	1221			Lost TTM
103.sgy	1831	1284			Reacquire TTM
103.sgy	1838	2326			EOL 103
106.sgy	1845	106	0.4 sec	0.3 m	SOL 106 HDG: 320°
106.sgy	1851	916			Lost TTM
106.sgy	1852	1118			Reacquire TTM
106.sgy	1902	2584			Lost TTM
106.sgy	1902	2650			Reacquire TTM
106.sgy	1912	4118			Lost TTM
106.sgy	1912	4185			Reacquire TTM
106.sgy	1922	5652			Lost TTM
106.sgy	1923	5721			Reacquire TTM
106.sgy	1931	7046			EOL 106
110.sgy	1933	176	0.4 sec	0.3 m	SOL 110 HDG: 140°
110.sgy	1933	180			No TTM at SOL; Reacquire TTM at File 180
110.sgy	1943	1647			Lost TTM
110.sgy	1943	1712			Reacquire TTM
110.sgy	1953	3178			Lost TTM
110.sgy	1953	3242			Reacquire TTM
110.sgy	2003	4710			Lost TTM
110.sgy	2004	4790			Reacquire TTM
110.sgy	2013	6213			EOL 110
208.sgy	2037	208	0.4 sec	0.3 m	SOL 208 HDG: 060°
208.sgy	2042	912			Lost TTM
208.sgy	2043	977			Reacquire TTM
208.sgy	2052	2446			Lost TTM
208.sgy	2053	2513			Reacquire TTM
208.sgy	2056	3039			EOL 208
206.sgy	2058	206	0.4 sec	0.3 m	SOL 206 HDG: 240°
206.sgy	2107	1550			Lost TTM
206.sgy	2107	1613			Reacquire TTM
206.sgy	2117	3069			EOL 206
204.sgy	2119	204	0.4 sec	0.3 m	SOL 204 HDG: 058°
204.sgy	2119	273			No TTM at SOL; Reacquire TTM at File 273
204.sgy	2129	1745			Lost TTM
204.sgy	2130	1807			Reacquire TTM
204.sgy	2138	3084			EOL 204
202.sgy	2139	202	0.4 sec	0.3 m	SOL 202 HDG: 235°
202.sgy	2139	234			Lost TTM
202.sgy	2140	302			Reacquire TTM
202.sgy	2150	1769			Lost TTM
					Continued on Page 3

FIELD LOG / OBSERVERS REPORT

Page 3

Client	Date	Area and / or Block		Operator / Observer	Line number	Line Direction
Geoscience	Apr 29 2015	Oceanside		Barth/Legg	see below	see below

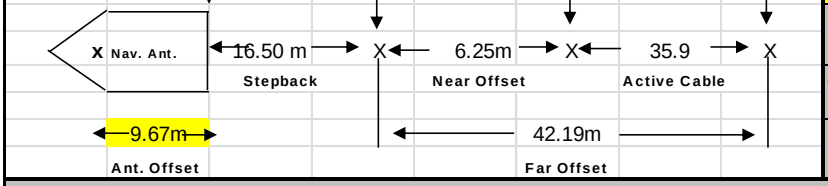
File Name	Time UTC	File Number	Speed Rep Rate	Cable depth Meters	Remarks (Changes in weather, sea state, operator, record delays, problems, etc.)		
202.sgy	2150	1831	0.4 sec	0.3 m	Reacquire TTM		
202.sgy	2200	3297			Lost TTM		
202.sgy	2200	3369			Reacquire TTM		
202.sgy	2201	3394			EOL 202		
205.sgy	2204	205	0.4 sec	0.3 m	SOL 205	HDG:	055°
205.sgy	2210	1118			Lost TTM		
205.sgy	2211	1245			Reacquire TTM		
205.sgy	2221	2710			Lost TTM		
205.sgy	2221	2775			Reacquire TTM		
205.sgy	2225	3328			EOL 205		
203.sgy	2226	203	0.4 sec	0.3 m	SOL 203	HDG:	
203.sgy	2229	615			ABORT 203		
					Wind and swell increasing		
201.sgy	2230	201	0.4 sec	0.3 m	SOL 201	HDG:	240°
201.sgy	2231	392			Lost TTM		
201.sgy	2231	445			Reacquire TTM		
201.sgy	2241	1922			Lost TTM		
201.sgy	2242	1984			Reacquire TTM		
201.sgy	2247	2770			EOL 201		
1203.sgy	2249	1203	0.4 sec	0.3 m	SOL 1203	HDG:	
1203.sgy	2251	1536			Lost TTM		
1203.sgy	2252	1600			Reacquire TTM		
1203.sgy	2303	2532			Lost TTM		
1203.sgy	2304	2689			ABORT 1203	Generator Problems	
					Weather deteriorating		
	2310				Retrieve gear		
	2330				Arrive at Dock		

Table 3-2. Field log/observers report for 30 April 2015.

FIELD LOG / OBSERVERS REPORT

Page 1

Vessel: M/V Theory



Client	Date
Geoscience	Apr 30 2015

Area and / or Block: Oceanside

Line number: see below

Operator / Observer: Barth \ Legg

Line Direction: see below

Instrumentation

Source type	Source power	Pre amp gain	Number of Guns	Plates	Sleeves	Source depth	Other
AP1000	300 joules	18 db		1		0.3 m	

	Sample Int.		Record Length		No. of channels	Cable depth:	0.3	m.
Primary	0.250	ms.	300	msec.	24	Signature Hydrophone depth		
Secondary		ms.		Sec.				

Filter		Filter		60 HZ Notch	Other	Note: no aux channels recorded
Low	Slope	High	Slope			
Out		Out		Out		

Cable layout

	Type	Format	Tape Drives	Far TR No.	Far offset	
Recording Instruments	Geo-Eel	SEG Y (IBM)	Hard Disk/ USB Disk	24	42.19	m.

	Primary	Secondary	Near TR No.	Near offset	
Navigation System	Differential GPS - Eco-M		1	6.25	m.

Boat speed		Navigation fix interval	Group Interval.	Shooting Interval
4	Knots		1.56 m	0.75 m

File Name	Time UTC	File Number	Speed Rep Rate	Cable depth Meters	Remarks (Changes in weather, sea state, operator, record delays, problems, etc.)
					Underway (0650 Local)
					Deploy gear in Harbor
					Gear deployed
					Problems with Bang Box; return to dock
					Ascertain that the Bang Box is not working.
					Arrange to pick up replacement in Huntington Beach
					Replace Bang Box with spare; all okay
					Underway and deploy gear
					Change record length to .35 sec
121.sgy	2011	121	**.45 sec**	0.3 m	SOL 121 HDG: 160°
121.sgy	2011	179			No TTM at SOL; Reacquire TTM at File 180
121.sgy	2021	1486			Lost TTM
121.sgy	2025	1978			Reacquire TTM
121.sgy	2034	3281			Lost TTM
121.sgy	2035	3334			Reacquire TTM
121.sgy	2038	3756			EOL 121
109.sgy	2041	109	**.45 sec**	0.3 m	SOL 109 HDG: 325°
109.sgy	2045	665			Lost TTM
109.sgy	2045	724			Reacquire TTM
109.sgy	2055	2034			Lost TTM
109.sgy	2056	2114			Reacquire TTM
109.sgy	2105	3419			Lost TTM
109.sgy	2106	3476			Reacquire TTM
109.sgy	2106	3494			EOL 109
					Change RL to .30 sec; Rep Rate to 0.40 sec
107.sgy	2110	107	.4 sec	0.3 m	SOL 107 HDG:
107.sgy	2115	272			ABORT 107 Recording System Problem; Reset
					Continued on Page 2

FIELD LOG / OBSERVERS REPORT

Page 2

Client	Date	Area and / or Block		Operator / Observer	Line number	Line Direction
Geoscience	Apr 30 2015	Oceanside		Barth/Legg	see below	see below

File Name	Time UTC	File Number	Speed Rep Rate	Cable depth Meters	Remarks (Changes in weather, sea state, operator, record delays, problems, etc.)
1107.sgy	2116	1107	0.4 sec	0.3 m	SOL 1107 HDG: 120°
1107.sgy	2116	1109			Lost TTM
1107.sgy	2116	1173			Reacquire TTM
1107.sgy	2126	2641			Lost TTM
1107.sgy	2126	2708			Reacquire TTM
1107.sgy	2134	3914			EOL 1107
108.sgy	2141	108	0.4 sec	0.3 m	SOL 108 HDG: 325°
108.sgy	2142	183			No TTM at SOL; Reacquire TTM at File 183
108.sgy	2152	1647			Lost TTM
108.sgy	2152	1711			Reacquire TTM
108.sgy	2201	3031			EOL 108
122.sgy	2209	122	0.4 sec	0.3 m	SOL 122 HDG: 115°
122.sgy	2217	1255			Lost TTM
122.sgy	2217	1327			Reacquire TTM
122.sgy	2227	2794			Lost TTM
122.sgy	2227	2858			Reacquire TTM
	2233	3656			EOL 122
213.sgy	2234	213	0.4 sec	0.3 m	SOL 213 HDG: 240°
213.sgy	2237	687			Lost TTM
213.sgy	2238	752			Reacquire TTM
213.sgy	2248	2219			Lost TTM
213.sgy	2248	2283			Reacquire TTM
213.sgy	2249	2493			EOL 213
211.sgy	2302	211	0.4 sec	0.3 m	SOL 211 HDG: 055°
211.sgy	2302	211			No TTM at SOL; Change out GPS antenna
211.sgy	2312	1738			Reacquire TTM
211.sgy	2318	2612			EOL 211
209.sgy	2319	209	0.4 sec	0.3 m	SOL 209 HDG: 235°
209.sgy	2322	634			Lost TTM
209.sgy	2323	703			Reacquire TTM
209.sgy	2332	2179			Lost TTM
209.sgy	2333	2243			Reacquire TTM
209.sgy	2338	3068			EOL 209
212.sgy	2343	212	0.4 sec	0.3 m	SOL 212 HDG: 055°
212.sgy	2343	275			No TTM at SOL; Reacquire TTM at File 275
212.sgy	2353	1743			Lost TTM
212.sgy	2354	1855			Reacquire TTM
212.sgy	0000	2738			EOL 212 Start New UTC Day: 1 May 2015
210.sgy	0002	210	0.4 sec	0.3 m	SOL 210 HDG: 240°
210.sgy	0011	1660			Lost TTM
210.sgy	0012	1722			Reacquire TTM
210.sgy	0021	3189			Lost TTM
210.sgy	0022	3253			Reacquire TTM
210.sgy	0025	3749			EOL 210 Shutdown for whales
					Continued on Page 3

FIELD LOG / OBSERVERS REPORT

Page 3

Client	Date	Area and / or Block	Operator / Observer	Line number	Line Direction
Geoscience	Apr 30 2015	Oceanside	Barth/Legg	see below	see below

File Name	Time UTC	File Number	Speed Rep Rate	Cable depth Meters	Remarks (Changes in weather, sea state, operator, record delays, problems, etc.)		
207.sgy	0048	207	0.4 sec	0.3 m	SOL 207	HDG:	145°
207.sgy	0057	1665			Lost TTM		
207.sgy	0058	1758			Reacquire TTM		
207.sgy	0108	3219			Lost TTM		
207.sgy	0109	3348			Reacquire TTM		
207.sgy	0118	4816			Lost TTM		
207.sgy	0123	5525			Reacquire TTM		
207.sgy	0133	6994			Lost TTM		
207.sgy	0133	7061			Reacquire TTM		
207.sgy	0140	8042			EOL 207		
2203.sgy	0142	2203	0.4 sec	0.3 m	SOL 2203	HDG:	240°
2203.sgy	0151	3491			Lost TTM		
2203.sgy	0151	3354			Reacquire TTM		
2203.sgy	0201	5018			Lost TTM		
2203.sgy	0201	5081			Reacquire TTM		
2203.sgy	0203	5321			EOL 2203		
					End of Survey		
	0215				Retrieve gear		
	0254				Arrive at Dock		

4.0 REFERENCES

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APPENDIX A

MARINE MAMMAL OBSERVER REPORT

High-Resolution San Luis Rey Geophysical Survey
Oceanside, CA

Marine Mammal Observer Report

Vessel: R/V Theory
Marine Mammal Observer: Kristen Sanchez
Dates of survey: April 29-30, 2015

The results of the Marine Mammal Observer report are described below. Daily field log reports are found in Tables 3-3 and 3-4.

Survey Date: 29 April 2015

Arrived at the R/V Theory at 06:30am. After loading gear, setting up, and a safety orientation of the vessel we departed the dock at 09:19am.

In transit to the site, including in and out of the harbor, I observed the following marine mammals: California sea lions.

Sighting 1: 09:53
7 California sea lions (*Z. californianus*) –
Observed 7 California sea lions resting on a navigation buoy approximately 60m away at a bearing position of 0260. Sea lions appeared unaffected and no mitigation was taken or required because the California sea lions remained outside the exclusion zone of 100m from the vessel.

Direction of travel: Stationary
Total animals: 7
Distance when first observed: 60m
Closest distance to the vessel: 60m
Mitigation action: None taken (boom not in use)

Sighting 2: 09:57
7 California sea lions (*Z. californianus*) –
Observed 7 California sea lions resting on a navigation buoy approximately 150m away at a bearing position of 0020. Sea lions appeared unaffected and no mitigation was taken or required because the California sea lions remained outside the exclusion zone of 100m from the vessel.

Direction of travel: Stationary
Total animals: 7
Distance when first observed: 150m
Closest distance to the vessel: 150m
Mitigation action: Sea lions were resting on bouy, did not appear affected. Vessel was in transit and boom was not in use.

Sighting 3: 11:04
1 Gray whale (*Eschrichtius robustus*) –
Observed 1 Gray whale blow spout, back and fluke. The whale was observed 250m from the vessel at a bearing position of 146, traveling northwest. After signaling a deep-dive the whale was not seen again, the vessel finished the transect line and turned away from the last sighting. No mitigation action was taken or required because it did not come within 100m of the vessel.

Direction of travel: Northwest
Total animals: 1
Distance when first observed: 250m
Closest distance to the vessel: 250m
Mitigation action: None taken

Sighting 4: 11:32
2 Gray whales (*Eschrichtius robustus*) –
Observed the surface blows of 2 Gray whales. The whales were observed 400m from the vessel at a bearing position of 146, traveling in an unknown direction. The vessel finished the transect line booming. No mitigation action was taken or required because the Gray whale did not come within 100m of the vessel.

Direction of travel: Unknown
Total animals: 2
Distance when first observed: 400m
Closest distance to the vessel: 400m
Mitigation action: None taken

Sighting 5: 11:33
2-3 Gray whales (*Eschrichtius robustus*) –
Observed surface blows of 2-3 Gray whales. The whale were observed 350m from the vessel at a bearing position of 166, traveling northwest. The vessel was approaching the pier, and finished transect line. No mitigation action was taken or required because the Gray whale did not come within 100m of the vessel.

Direction of travel: Northwest
Total animals: 2
Distance when first observed: 350m
Closest distance to the vessel: 350m
Mitigation action: None taken

Sighting 6: 11:38
1 Gray whale (*Eschrichtius robustus*) –
Observed surface blow of 1 Gray whale. The whale was observed 175m from the vessel at a bearing position of 247 traveling northwest. The Gray whale was observed just outside exclusion zone diving down as the vessel turned toward the whale to go around the end of the pier; the next sighting of whale was farther away. No mitigation action was taken or required because the Gray whale did not come within 100m of the vessel.

Direction of travel: Northwest
Total animals: 1
Distance when first observed: 175m
Closest distance to the vessel: 175m
Mitigation action: None taken

Sighting 7: 11:41
1 Gray whale (*E. robustus*) –
Observed the surface blow of 1 Gray whale. The whale was observed 200m from the vessel at a bearing position of 306 traveling northwest. After signaling a deep-dive the whale was not seen again, the vessel finished the transect line and turned away from the last sighting. No mitigation action was taken or required because the Gray whale did not come within 100m of the vessel.

Direction of travel: Northwest
Total animals: 1
Distance when first observed: 200m
Closest distance to the vessel: 200m
Mitigation action: None taken

End of survey was around 15:59 and our boat docked in the harbor at 16:30.

Survey Date: 30 April 2015

Arrived at the R/V Theory at 06:30. After loading gear and setting up we departed the dock at 06:53.

Pre-watch began inside the harbor at 07:00. Equipment was deployed; attempt at starting the boomer failed. Pre-watch was clear. 07:34 Return to dock for further trouble-shooting of equipment failure; later determined that we would need to wait for a "bang box" to be supplied from Fugro, in Ventura. 12:30 Re-convened at the boat with 2 bang boxes; 1st replacement failed, 2nd was functional. At12:57 Vessel underway for the second time. Pre-watch began at 13:04 inside the harbor, near the entrance.

In transit to the site, including in and out of the harbor I observed the following marine mammals: California sea lions, unidentified dolphins, Common dolphins, harbor seals, and Gray whales.

Sighting 1: 14:56
8 California Sea Lions (*Zalophus californianus*) –
Observed 8 California sea lions resting on a buoy approximately 120m away at a bearing position of 268. Sea lions appeared unaffected and no mitigation was taken or required because the California sea lions remained outside the exclusion zone of 100m from the vessel.

Direction of travel: Stationary
Total animals: 8
Distance when first observed: 120m

Closest distance to the vessel: 120m
Mitigation action: None taken, vessel was running transect lines near the buoy, sea lions appeared unaffected.

Sighting 2: 15:41
2 California Sea Lions (*Zalophus californianus*) –
Observed 2 California Sea Lions attempting to swim away from the vessel which was traveling in the same direction as the seals. The sea lions were observed 75m away from the vessel at a bearing position of 200. Shut-down of the vessel was requested due to the sea lions proximity, the animals appeared to be attempting to swim away from the source even though the vessel was traveling in the same direction; since the vessel was near the end of a transect line, they did not finish off the end of that line and the generator was refueled.

Direction of travel: Swimming away in the same direction of travel as the vessel
Total animals: 2
Distance when first observed: 75m
Closest distance to the vessel: 75m
Mitigation action: Vessel shut-down requested, end of transect line was not completed

Sighting 3: 15:54
2-3 Un-ID Dolphin–
Observed 2-3 unidentified dolphins displaying body slaps 300m away from the vessel at a bearing of 170. Their bodies appeared smaller than a Bottlenose, and displayed lighter sides, assumed to likely be Common dolphins, given the large pod sighted ~30 minutes later in the same vicinity. The dolphins appeared unaffected and no mitigation was taken or required as they remained outside the exclusion zone of 100m from the vessel.

Direction of travel: Stationary
Total animals: 2-3
Distance when first observed: 300m
Closest distance to the vessel: 300m
Mitigation action: None taken

Sighting 4: 16:32
1 California Sea Lion (*Zalophus californianus*) –
Observed 1 California Sea Lion swimming in the opposite direction of the vessel, passing parallel to the ship with its head above the water. The sea lion was observed 100m away from the vessel at a bearing position of 146. The sea lion appeared unaffected and no mitigation was taken or required as it remained outside the exclusion zone of 100m from the vessel.

Direction of travel: Northeast
Total animals: 1
Distance when first observed: 100m
Closest distance to the vessel: 100m
Mitigation action: None taken

Sighting 5: 17:21
~300+ Common Dolphin (*Delphinus delphis*) –

Observed around 300 Common Dolphin porpoising and traveling in an intersecting trajectory to the vessel. The dolphins were observed at a distance 300m away from the vessel at a bearing position of 200. The dolphins appeared unaffected and no mitigation was taken or required as they remained outside the exclusion zone of 100m from the vessel.

Direction of travel: West
Total animals: ~300+
Distance when first observed: 300m
Closest distance to the vessel: 300m
Mitigation action: None taken

Sighting 6: 17:25
2 Gray Whales (*Eschrichtius robustus*) –

Observed 2 Gray Whales, a mother and calf, swimming across the path of the bow of the boat. The whales were observed at a distance of 150m away from the vessel at a bearing position of 240. Shut-down was requested due to the Gray whale mother and calf crossing the bow, while the large pod of Common dolphin continued to move in an intersecting trajectory, as the vessel was near the end of the transect line the equipment was pulled in for a run farther offshore, where the long transect line toward shore was started

Direction of travel: Northwest
Total animals: 2
Distance when first observed: 150m
Closest distance to the vessel: 150m
Mitigation action: Shut down requested, vessel activities redirected

Sighting 7: 17:44
1 Harbor Seal (*Phoca vitulina*) –

Observed 1 Harbor Seal resting with its head above the water approximately 150m from the vessel. The seal was observed at a bearing position of 315. The seal appeared unaffected and no mitigation was taken or required as it remained outside the exclusion zone of 100m from the vessel.

Direction of travel: Stationary
Total animals: 1
Distance when first observed: 150m
Closest distance to the vessel: 150m
Mitigation action: None taken

Sighting 8: 18:00
1 Harbor Seal (*Phoca vitulina*) –

Observed 1 Harbor Seal resting with its head above the water approximately 100m from the vessel. The seal was observed at a bearing position of 85. The seal appeared unaffected and

no mitigation was taken or required as it remained outside the exclusion zone of 100m from the vessel.

Direction of travel: Stationary
Total animals: 1
Distance when first observed: 100m
Closest distance to the vessel: 100m
Mitigation action: None taken

Sighting 9: 18:05

~300+ Common Dolphin (*Delphinus delphis*) –

Observed a pod of ~300+ Common Dolphin crossing the vessel's transect line in the distance. The vessel was traveling northeast as the dolphins were traveling northwest. They appeared to be the tail end of the pod spotting at 17:21. The dolphins were observed at a distance 300m away from the vessel at a bearing position of 30. The pod appeared unaffected and no mitigation was taken or required as they remained outside the exclusion zone of 100m from the vessel.

Direction of travel: Northwest
Total animals: ~300+
Distance when first observed: 300m
Closest distance to the vessel: 300m
Mitigation action: None taken

Sighting 10: 18:35

1 California Sea Lion (*Zalophus californianus*) –

Observed 1 California Sea Lion porpoising, traveling away from the boat. The sea lion was observed at a distance of 150m away from the vessel at a bearing position of 350. The seal appeared unaffected and no mitigation was taken or required as it remained outside the exclusion zone of 100m from the vessel.

Direction of travel: West
Total animals: 1
Distance when first observed: 150m
Closest distance to the vessel: 150m
Mitigation action: None taken

Over the course of 2 days, 17 marine mammal sightings were recorded, 2 of which required shut-downs as mitigation action for compliance with the marine wildlife protection plan. One shut-down was due to a California sea lion that appeared in distress, and the other for a mother/calf Gray whale pair within the exclusion zone combined with the immediate likelihood of intersecting an on-coming pod of Common dolphin.

Table A-1. Marine mammal sightings for 29 April 2015.

Sighting No.	Time (PDT)	Bearing	Dist. From Source (m)	Vessel Activity	Species	No. of Animals Observed	Direction of Travel	Behavior
1	09:53	260	60	moving, no boom	California sea lion	7	Stationary	resting on bouy
2	09:57	20	150	ramp up of boomer	California sea lion	7	Stationary	resting on bouy
3	11:04	146	250	finishing transect line, booming	Gray whale	1	NW	2 blows, then sounding dive (fluked); not seen again
4	11:32	146	400	finishing transect line, booming	Gray whale	2	Unknown	surface blows
5	11:33	166	350	approaching the pier, booming	Gray whale	2-3	NW	surface blows
6	11:38	247	175	on transect around end of pier, booming	Gray whale	1	NW	surface blows
7	11:41	306	200	on transect south of pier, booming	Gray whale	1	NW	surface blows

Table A-2. Marine mammal sightings for 30 April 2015.

Sighting No.	Time (PDT)	Bearing	Dist. From Source (m)	Vessel Activity	Species	No. of Animals Observed	Direction of Travel	Behavior
1	14:56	268	120	on transect, booming	California sea lion	8	Stationary	resting on bouy
2	15:41	200	75	finishing transect line, shut down requested	California sea lion	2	SW	swimming away in same direction as boat travel
3	15:54	170	300	on transect, booming	Un-ID dolphin	2-3	E	body slaps
4	16:32	146	100	on transect, booming	California sea lion	1	NE	swimming in opposite direction, passing parallel to boat, head above water
5	17:21	200	300	on transect, booming	Common dolphin	~300	W	porpoising, traveling in a intersecting trajectory
6	17:25	240	150	shut down due to whales and dolphins	Gray whale	2	NW	mother & calf, crossing the bow
7	17:44	315	150	on transect, booming	Harbor seal	1	Stationary	resting, head above water
8	18:00	85	100	on transect, booming	Harbor seal	1	Stationary	resting, head above water
9	18:05	30	300	on transect, booming	Common dolphin	~300	NW	tail end of same group, crossing bow
10	18:35	350	150	on transect, booming	California sea lion	1	W	porpoising, traveling away from the boat

EXHIBIT H

Mitigation Monitoring Program

Mitigation Measure (MM)	Location and Scope of Mitigation	Effectiveness Criteria	Monitoring or Reporting Action	Responsible Party	Timing	Implementation Date(s) and Initials
Air Quality and Greenhouse Gas (GHG) Emissions (MND Section 3.3.3)						
MM AIR-1: Engine Tuning, Engine Certification, and Fuels. The following measures will be required to be implemented by all Permittees under the Offshore Geophysical Permit Program (OGPP), as applicable depending on the county offshore which a survey is being conducted. Pursuant to section 93118.5 of CARB's Airborne Toxic Control Measures, the Tier 2 engine requirement applies only to diesel-fueled vessels.	All Counties: Maintain all construction equipment in proper tune according to manufacturers' specifications; fuel all off-road and portable diesel-powered equipment with California Air Resources Board (CARB)-certified motor vehicle diesel fuel limiting sulfur content to 15 parts per million or less (CARB Diesel).	Daily emissions of criteria pollutants during survey activities are minimized.	Determine engine certification of vessel engines. Review engine emissions data to assess compliance, determine if changes in tuning or fuel are required.	OGPP permit holder and contract vessel operator; California State Lands Commission (CSLC) review of Final Monitoring Report.	Prior to, during, and after survey activities. Submit Final Monitoring Report after completion of survey activities.	N/A- exempt-gasoline vessel
	Los Angeles and Orange Counties: Use vessel engines meeting CARB's Tier 2-certified engines or cleaner; the survey shall be operated such that daily NOx emissions do not exceed 100 pounds based on engine certification emission factors. This can be accomplished with Tier 2 engines if daily fuel use is 585 gallons or less, and with Tier 3 engines if daily fuel use is 935 gallons or less		Verify that Tier 2 or cleaner engines are being used. Calculate daily NOx emissions to verify compliance with limitations.			N/A- exempt-gasoline vessel
	San Luis Obispo County: Use vessel engines meeting CARB's Tier 2-certified engines or cleaner, accomplished with Tier 2 engines if daily fuel use is 585 gallons or less; all diesel equipment shall not idle for more than 5 minutes; engine use needed to maintain position in the water is not considered idling; diesel idling within 300 meters (1,000 feet) of sensitive receptors is not permitted; use alternatively fueled construction equipment on site where feasible, such as compressed natural gas, liquefied natural gas, propane or biodiesel.		Verify that Tier 2 or cleaner engines are being used. Inform vessel operator(s) of idling limitation. Investigate availability of alternative fuels			N/A- exempt-gasoline vessel
	Santa Barbara County: Use vessel engines meeting CARB's Tier 2-certified engines or cleaner, accomplished with Tier 2 engines if daily fuel use is 790 gallons or less.		Verify that Tier 2 or cleaner engines are being used. Investigate availability of alternative fuels			N/A- exempt-gasoline vessel
	Ventura County: Use alternatively fueled construction equipment on site where feasible, such as compressed natural gas, liquefied natural gas, propane or biodiesel.		Investigate availability of alternative fuels.			N/A- exempt-gasoline vessel

Mitigation Measure (MM)	Location and Scope of Mitigation	Effectiveness Criteria	Monitoring or Reporting Action	Responsible Party	Timing	Implementation Date(s) and Initials
MM BIO-1: Marine Mammal and Sea Turtle Presence – Current Information.	All State waters; prior to commencement of survey operations, the geophysical operator shall: (1) contact the National Oceanic and Atmospheric Administration Long Beach office staff and local whale-watching operations and shall acquire information on the current composition and relative abundance of marine wildlife offshore, and (2) convey sightings data to the vessel operator and crew, survey party chief, and onboard Marine Wildlife Monitors (MWMs) prior to departure. This information will aid the MWMs by providing data on the approximate number and types of organisms that may be in the area.	No adverse effects to marine mammals or sea turtles due to survey activities are observed.	Document contact with appropriate sources. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder; Inquiry to NOAA and local whale watching operators.	Prior to Survey	NE 3/14/15
MM BIO-2: Marine Wildlife Monitors (MWMs).	Except as provided in section 7(h) of the General Permit, a minimum of two (2) qualified MWMs who are experienced in marine wildlife observations shall be onboard the survey vessel throughout both transit and data collection activities. The specific monitoring, observation, and data collection responsibilities shall be identified in the Marine Wildlife Contingency Plan required as part of all Offshore Geophysical Permit Program permits. Qualifications of proposed MWMs shall be submitted to the National Oceanic and Atmospheric Administration (NOAA) and CSLC at least twenty-one (21) days in advance of the survey for their approval by the agencies. Survey operations shall not commence until the CSLC approves the MWMs.	Competent and professional monitoring or marine mammals and sea turtles; compliance with established monitoring policies.	Document contact with and approval by appropriate agencies. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Prior to survey.	KS 4/29/15
MM BIO-3: Safety Zone Monitoring.	Onboard Marine Wildlife Monitors (MWMs) responsible for observations during vessel transit shall be responsible for monitoring during the survey equipment operations. All visual monitoring shall occur from the highest practical vantage point aboard the survey vessel; binoculars shall be used to observe the surrounding area, as appropriate. The MWMs will survey an area (i.e., safety or exclusion zone) based on the equipment used, centered on the sound source (i.e., vessel, towfish), throughout time that the survey equipment is operating. Safety zone radial distances, by equipment type, include:	No adverse effects to marine mammals or sea turtles due to survey activities are observed; compliance with established safety zones.	Compliance with permit requirements (observers); compliance with established safety zones. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Prior to survey.	KS 4/29/15

Equipment Type Safety Zone (radius, m)	Equipment Type Safety Zone (radius, m)
Single Beam Echosounder	50
Multibeam Echosounder	500
Side-Scan Sonar	600
Subbottom Profiler	100
Boomer System	100

If the geophysical survey equipment is operated at or above a frequency of 200 kilohertz (kHz), safety zone monitoring and enforcement is not required; however, if geophysical survey equipment operated at a frequency at or above 200 kHz is used simultaneously with geophysical survey equipment less than 200 kHz, then the safety zone for the equipment less than 200 kHz must be monitored. The onboard MWMs shall have authority to stop operations if a mammal or turtle is observed within the specified safety zone and may be negatively affected by survey activities. The MWMs shall also have authority to recommend continuation (or cessation) of operations during periods of limited visibility (i.e., fog, rain) based on the observed abundance of marine wildlife. Periodic reevaluation of weather conditions and reassessment of the continuation/cessation recommendation shall be completed by the onboard MWMs. During operations, if an animal's actions are observed to be irregular, the monitor shall have authority to recommend that equipment be shut down until the animal moves further away from the sound source. If irregular behavior is observed, the equipment shall be shut-off and will be restarted and ramped-up to full power, as applicable, or will not be started until the animal(s) is/are outside of the safety zone or have not been observed for 15 minutes. For nearshore survey operations utilizing vessels that lack the personnel capacity to hold two (2) MWMs aboard during survey operations, at least twenty-one (21) days prior to the commencement of survey activities, the Permittee may petition the CSLC to conduct survey operations with one (1) MWM aboard. The CSLC

	will consider such authorization on a case-by-case basis and factors the CSLC will consider will include the timing, type, and location of the survey, the size of the vessel, and the availability of alternate vessels for conducting the proposed survey. CSLC authorizations under this subsection will be limited to individual surveys and under any such authorization; the Permittee shall update the MWCP to reflect how survey operations will occur under the authorization.					
MM BIO-4: Limits on Nighttime OGPP Surveys.	All State waters; nighttime survey operations are prohibited under the OGPP, except as provided below. The CSLC will consider the use of single beam echosounders and passive equipment types at night on a case-by-case basis, taking into consideration the equipment specifications, location, timing, and duration of survey activity.	No adverse effects to marine mammals or sea turtles due to survey activities are observed.	Presurvey request for nighttime operations, including equipment specifications and proposed use schedule. Document equipment use. Submit Final Monitoring Report after completion of survey activities	OGPP permit holder.	Approval required before survey is initiated. Monitoring Report following completion of survey.	KS 4/29/15
MM BIO-5: Soft Start.	All State waters; the survey operator shall use a "soft start" technique at the beginning of survey activities each day (or following a shut down) to allow any marine mammal that may be in the immediate area to leave before the sound sources reach full energy. Surveys shall not commence at nighttime or when the safety zone cannot be effectively monitored. Operators shall initiate each piece of equipment at the lowest practical sound level, increasing output in such a manner as to increase in steps not exceeding approximately 6 decibels (dB) per 5- minute period. During ramp-up, the Marine Wildlife Monitors (MWMs) shall monitor the safety zone. If marine mammals are sighted within or about to enter the safety zone, a power-down or shut down shall be implemented as though the equipment was operating at full power. Initiation of ramp-up procedures from shut down requires that the MWMs be able to visually observe the full safety zone.	No adverse effects to marine mammals or sea turtles due to survey activities are observed.	Compliance with permit requirements (observers); compliance with safe start procedures. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Immediately prior to survey.	MJ 04-29 Apr 15

MM BIO-6: Practical Limitations on Equipment Use and Adherence to Equipment Manufacturer's Routine Maintenance Schedule.	All State waters; geophysical operators shall follow, to the maximum extent possible, the guidelines of Zykov (2013) as they pertain to the use of subbottom profilers and sidescan sonar, including: • Using the highest frequency band possible for the subbottom profiler; • Using the shortest possible pulse length; and • Lowering the pulse rate (pings per second) as much as feasible. Geophysical operators shall consider the potential applicability of these measures to other equipment types (e.g., boomer). Permit holders will conduct routine inspection and maintenance of acoustic-generating equipment to ensure that low energy geophysical equipment used during permitted survey activities remains in proper working order and within manufacturer's equipment specifications. Verification of the date and occurrence of such equipment inspection and maintenance shall be provided in the required presurvey notification to CSLC.	No adverse effects to marine mammals or sea turtles due to survey activities are observed.	Document initial and during survey equipment settings. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Immediately prior to and during survey.	ML 04-29 Apr 15
MM BIO-7: Avoidance of Pinniped Haul-Out Sites.	The Marine Wildlife Contingency Plan (MWCP) developed and implemented for each survey shall include identification of haul-out sites within or immediately adjacent to the proposed survey area. For surveys within 300 meters (m) of a haul-out site, the MWCP shall further require that: • The survey vessel shall not approach within 91 m of a haul-out site, consistent with National Marine Fisheries Service (NMFS) guidelines; • Survey activity close to haul-out sites shall be conducted in an expedited manner to minimize the potential for disturbance of pinnipeds on land; and • Marine Wildlife Monitors shall monitor pinniped activity onshore as the vessel approaches, observing and reporting on the number of pinnipeds potentially disturbed (e.g., via head lifting, flushing into the water). The purpose of such reporting is to provide CSLC and California Department of Fish and Wildlife (CDFW) with information regarding potential	No adverse effects to pinnipeds at haul outs are observed.	Document pinniped reactions to vessel presence and equipment use. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Monitoring Report following completion of survey	NE 3/14/15
MM BIO-8: Reporting Requirements –	All State waters; if a collision with marine mammal or reptile occurs, the vessel operator shall document the conditions under which the accident occurred, including	No adverse effects to marine mammals or sea	Submit Final Monitoring Report after completion of survey	OGPP permit holder.	Monitoring Report following	N/A No Collisions Reported 04-29 /

Collision.	the following: • Vessel location (latitude, longitude) when the collision occurred; • Date and time of collision; • Speed and heading of the vessel at the time of collision; • Observation conditions (e.g., wind speed and direction, swell height, visibility in miles or kilometers, and presence of rain or fog) at the time of collision; • Species of marine wildlife contacted (if known); • Whether an observer was monitoring marine wildlife at the time of collision; and, • Name of vessel, vessel owner/operator, and captain officer in charge of the vessel at time of collision. After a collision, the vessel shall stop, if safe to do so; however, the vessel is not obligated to stand by and may proceed after confirming that it will not further damage the animal by doing so. The vessel will then immediately communicate by radio or telephone all details to the vessel's base of operations, and shall immediately report the incident. Consistent with Marine Mammal Protection Act requirements, the vessel's base of operations or, if an onboard telephone is available, the vessel captain him/herself, will then immediately call the National Oceanic and Atmospheric Administration (NOAA) Stranding Coordinator to report the collision and follow any subsequent instructions. From the report, the Stranding Coordinator will coordinate subsequent action, including enlisting the aid of marine mammal rescue organizations, if appropriate. From the vessel's base of operations, a telephone call will be placed to the Stranding Coordinator, NOAA National Marine Fisheries Service (NMFS), Southwest Region, Long Beach, to obtain instructions. Although NOAA has primary responsibility for marine mammals in both State and Federal waters, the California Department of Fish and Wildlife (CDFW) will also be advised that an incident has occurred in State waters affecting a protected species.	turtles due to survey activities are observed.	activities.		completion of survey.	04-30 Apr 15
MM BIO-9: Limitations on	All MPAs; prior to commencing survey activities, geophysical operators shall coordinate with the CLSC,	No adverse effects to MPA	Monitor reactions of wildlife to survey	OGPP permit holder; survey	Prior to survey.	N/A No MPAs in project area

Survey Operations in Select Marine Protected Areas (MPAs).	California Department of Fish and Wildlife (CDFW), and any other appropriate permitting agency regarding proposed operations within MPAs. The scope and purpose of each survey proposed within a MPA shall be defined by the permit holder, and the applicability of the survey to the allowable MPA activities shall be delineated by the permit holder. If deemed necessary by CDFW, geophysical operators will pursue a scientific collecting permit, or other appropriate authorization, to secure approval to work within a MPA, and shall provide a copy of such authorization to the CSLC as part of the required presurvey notification to CSLC. CSLC, CDFW, and/or other permitting agencies may impose further restrictions on survey activities as conditions of approval	resources due to survey activities are observed.	operations; report on shutdown conditions and survey restart. Submit Final Monitoring Report after completion of survey activities.	permitted by CDFW.		
MM HAZ-1: Oil Spill Contingency Plan (OSCP) Required Information.	Permittees shall develop and submit to CSLC staff for review and approval an OSCP that addresses accidental releases of petroleum and/or non-petroleum products during survey operations. Permittees' OSCPs shall include the following information for each vessel to be involved with the survey: • Specific steps to be taken in the event of a spill, including notification names, phone numbers, and locations of: (1) nearby emergency medical facilities, and (2) wildlife rescue/response organizations (e.g., Oiled Wildlife Care Network); • Description of crew training and equipment testing procedures; and • Description, quantities, and location of spill response equipment onboard the vessel.	Reduction in the potential for an accidental spill. Proper and timely response and notification of responsible parties in the event of a spill.	Documentation of proper spill training. Notification of responsible parties in the event of a spill.	OGPP permit holder and contract vessel operator.	Prior to survey.	HE 3/17/15
MM HAZ-2: Vessel fueling restrictions.	Vessel fueling shall only occur at an approved docking facility. No cross vessel fueling shall be allowed.	Reduction in the potential for an accidental spill.	Documentation of fueling activities.	Contract vessel operator.	Following survey.	N/A- boat is trailered and fuels on land
MM HAZ-3: OSCP equipment and supplies.	Onboard spill response equipment and supplies shall be sufficient to contain and recover the worst-case scenario spill of petroleum products as outlined in the OSCP.	Proper and timely response in the event of a spill.	Notification to CSLC of onboard spill response equipment/supplies inventory, verify ability to respond to worst-case spill.	Contract vessel operator.	Prior to survey.	HE 3/17/15- supplies confirmed

MM HAZ-1: Oil Spill Contingency Plan (OSCP) Required Information.	Outlined under **Hazards and Hazardous Materials** (above)					HE 3/17/15
MM HAZ-2: Vessel fueling restrictions.	Outlined under **Hazards and Hazardous Materials** (above)					N/A- boat is trailered and fuels on land
MM HAZ-3: OSCP equipment and supplies.	Outlined under **Hazards and Hazardous Materials** (above)					HE 3/17/15
MM BIO-9: Limitations on Survey Operations in Select MPAs.	Outlined under **Biological Resources** (above)					N/A No MPAs
MM REC-1: U.S. Coast Guard (USCG), Harbormaster, and Dive Shop Operator Notification.	All California waters where recreational diving may occur; as a survey permit condition, the CSLC shall require Permittees to provide the USCG with survey details, including information on vessel types, survey locations, times, contact information, and other details of activities that may pose a hazard to divers so that USCG can include the information in the Local Notice to Mariners, advising vessels to avoid potential hazards near survey areas. Furthermore, at least twenty-one (21) days in advance of in-water activities, Permittees shall: (1) post such notices in the harbormasters' offices of regional harbors; and (2) notify operators of dive shops in coastal locations adjacent to the proposed offshore survey operations.	No adverse effects to recreational divers from survey operations.	Notify the USCG, local harbormasters, and local dive shops of planned survey activity. Submit Final Monitoring Report after completion of survey activities.	OGPP Permit holder.	Prior to survey.	NE 3/14/15